

TITLE OF THE INVENTION

SYSTEM AND METHOD FOR RESTORING DIGITAL TV SIGNAL

CLAIM OF PRIORITY

[0001] This application makes reference to, incorporates the same herein, and claims all benefits accruing under 35 U.S.C §119 from an application entitled *System and Method for Restoring Digital Tv Signal* earlier filed in the Korean Industrial Property Office on 16 July 2001, and there duly assigned Serial No. 2001-42812 by that Office.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates in general to a system and a method for restoring a digital TV signal, and more particularly, to a system and a method for restoring a digital TV signal in which the digital TV signal is wirelessly transmitted from a computer system and restored at a remote display apparatus.

Description of the Related Art

[0003] Currently, a digital broadcasting system transmits a TV signal, after digitizing audio and video signals thereof and compressing them, in an MPEG-2 (Motion Picture Experts Group-2) manner. Thus, a digital TV that can receive the digitized TV signal and display a picture in high quality is on the market.

[0004] Inside the digital TV is provided a signal processing part so as to receive and process the

1 compressed digital TV signal. However, some digital TV sets, e.g., a wall mounted digital TV set,
2 require a separate digital signal processing setup box in order to process the digital TV signal.

3 **[0005]** On the other hand, in the case of a computer system equipped with a digital TV tuner card,
4 if the computer system is connected to a display apparatus such as the digital TV or a projector, the
5 digital broadcasting can be displayed on the display apparatus without a digital signal processing
6 setup box.

7 **[0006]** Herein below, a computer system for displaying a digital TV signal, received at a digital
8 TV tuner card, on a digital TV, instead of the computer system's monitor, will be described. As
9 shown in Fig. 5, the computer system which can display the digital broadcasting is comprised of a
10 digital TV tuner card 111 receiving a digital TV signal and dividing it into an audio signal and a
11 video signal compressed in the MPEG-2 manner, a video decoder 114 outputting R/G/B signals by
12 decoding the video signal compressed in the MPEG-2 manner, a video signal transforming unit (not
13 shown), included in video decoder 114, transforming the R/G/B signals from the video decoder 114
14 into Y/Pb/Pr signals, a VGA (Video Graphics Adapter) card 117 processing the R/G/B signals from
15 the video decoder 114 and outputting an analog video signal, and a monitor 119 displaying the
16 analog video signal from the VGA card 117 thereon. The Y/Pb/Pr signals from the video
17 transforming unit is transmitted to and displayed on a digital TV 122.

18 **[0007]** Further, the audio signal from the digital TV tuner card 111 is transformed into an SPDIF
19 (Sony Philips Digital Interface Format) signal by a sound card 115, and divided into six audio data
20 corresponding to 5.1 (five speakers and one woofer) channels by an audio apparatus (an amplifier)
21 equipped with an audio decoder 123 so as to be outputted through speakers 124 through 129.

22 **[0008]** The computer system, however, is generally arranged in a one room, but the digital TV and
23 the audio apparatus applicable to the 5.1 channels are arranged in an a separate room. Accordingly,

1 a plurality of cables are needed for connecting the computer system to the digital TV and the audio
2 apparatus, thus a signal loss may be generated according to a length of the cables, and the beauty of
3 surroundings may be spoiled by the cables.

4 SUMMARY OF THE INVENTION

5 [0009] Accordingly, the present invention has been made keeping in mind the above-described
6 shortcomings and user's need, and an object of the present invention is to provide a system and a
7 method for restoring a digital TV signal, in which the digital TV signal is wirelessly transmitted
8 from a computer system and restored at a remote display apparatus.

9 [0010] This and other objects of the present invention may be accomplished by the provision of
10 a system for reproducing a digital TV signal, comprising a computer system and a display system,
11 in which the computer system comprises a signal dividing means receiving the digital TV signal, and
12 dividing the digital TV signal into digital video signals and digital audio signals after a
13 predetermined signal processing, a video decoding means decoding the digital video signals
14 outputted from the signal dividing means into analog video signals, and outputting low frequency
15 analog video signals by colors, an audio decoding means decoding the digital audio signals outputted
16 from the signal dividing means into analog audio signals with a plurality of channels corresponding
17 to predetermined frequencies, a plurality of frequency-modulators frequency-modulating the low
18 frequency analog video signals and the analog audio signals, in response to intermediate frequencies,
19 respectively, and a wireless transmitter wirelessly transmitting the signals modulated by the
20 frequency-modulators; and the display system having a plurality of first wireless receivers wirelessly
21 receiving the analog audio signals transmitted from the wireless transmitter, via the channels, a
22 plurality of first frequency demodulators respectively connected to the first wireless receivers and

1 frequency-demodulating the analog audio signals, a plurality of second wireless receivers wirelessly
2 receiving the analog video signals transmitted from the wireless transmitter, a plurality of second
3 frequency demodulators respectively connected to the second wireless receivers and frequency-
4 demodulating the analog video signals by the colors, and display and audio apparatuses outputting
5 the video and audio signals demodulated by the first and second frequency demodulators,
6 respectively.

7 **[0011]** Effectively, the signal dividing means is comprised of a digital TV tuner card including
8 a tuner receiving the digital TV signal, a VSB (Vestigial Side Band) demodulating part
9 demodulating a high frequency signal output by the tuner into a VSB analog signal, a Viterbi
10 decoder transforming the VSB analog signal into a digital signal, and a demultiplexer dividing the
11 digital signal transformed by the Viterbi decoder into a separate video signal and audio signal.

12 **[0012]** Further, the video decoding means includes a video decoder decoding the video signal
13 outputted from the demultiplexer into R/G/B signals, and a video signal transforming part
14 transforming the R/G/B signals into Y/Pb/Pr low frequency analog video signals.

15 **[0013]** The audio decoding means includes an audio decoder decoding the audio signal outputted
16 from the demultiplexer into six audio signals corresponding to the 5.1 channel audio format in an
17 AC-3 (Dolby Digital) manner. Effectively, the audio apparatus is comprised of six speakers
18 applicable to the 5.1 channels.

19 **[0014]** The wireless transmitter and the first and second wireless receivers are comprised of at
20 least one antenna, respectively.

21 **[0015]** This and other objects of the present invention may be accomplished by the provision of
22 a system for restoring a digital video signal, comprising a computer system and a display system,
23 in which the computer system comprising a video signal outputting means outputting the digital

1 video signal, a video decoding means decoding the digital video signals outputted from the video
2 signal outputting means into analog video signals, and outputting low frequency analog video signals
3 by colors, a plurality of frequency-modulators frequency-modulating the low frequency analog video
4 signals into high frequency signals, in response to intermediate frequencies, respectively, and a
5 wireless transmitter wirelessly transmitting the signals modulated by the frequency-modulators; and
6 the display system comprising a plurality of wireless receivers wirelessly receiving the analog video
7 signals transmitted from the wireless transmitter, a plurality of frequency demodulators respectively
8 connected to the wireless receivers and frequency-demodulating the analog video signals by colors,
and a display apparatus outputting the video signals demodulated by the frequency demodulators.

10 **[0016]** This and other objects of the present invention may be accomplished by the provision of
11 a system for restoring a digital audio signal, comprising a computer system and an audio system, in
12 which the computer system comprising an audio signal outputting means outputting the digital audio
13 signal, an audio decoding means decoding the digital audio signals outputted from the audio signal
14 outputting means into analog audio signals after dividing the digital audio signals corresponding to
15 a plurality of channels having predetermined frequencies, a plurality of frequency-modulators
16 frequency-modulating the low frequency analog audio signals into high frequency signals, in
17 response to intermediate frequencies, respectively, and a wireless transmitter wirelessly transmitting
18 the signals modulated by the frequency-modulators; and the audio system comprising a plurality of
19 wireless receivers wirelessly receiving the analog audio signals transmitted from the wireless
20 transmitter, a plurality of frequency demodulators respectively connected to the wireless receivers
21 and frequency-demodulating the analog audio signals corresponding to the channels, and an audio
22 apparatus outputting the audio signals demodulated by the frequency demodulators.

23 **[0017]** Preferably, the audio signal outputting means is comprised of a digital TV tuner card

1 including a tuner receiving the digital TV signal, a VSB (Vestigial Side Band) demodulating part
2 demodulating a high frequency signal received by the tuner into a VSB analog signal, a viterbi
3 decoder transforming the VSB analog signal into a digital signal, and a demultiplexer dividing the
4 digital signal transformed by the viterbi decoder into the video signal and the audio signal.

5 **[0018]** According to another aspect of the present invention, the above and other objects may be
6 also achieved by the provision of a method for restoring a digital TV signal, comprising the steps
7 of dividing the digital TV signal into a digital video signal and an digital audio signal after a
8 predetermined signal processing; decoding the digital video signal into low frequency analog video
9 signal, by colors; decoding the digital audio signal into analog audio signal with a plurality of
10 channels corresponding to predetermined frequencies; modulating the low frequency analog video
11 and audio signals into high frequency signals having predetermined intermediate frequencies,
12 respectively; transmitting at least one of the frequency-modulated video and audio signals by
13 wireless; receiving at least one of the transmitted video and audio signals and demodulating the
14 received signals; and outputting at least one of the demodulated video and audio signals to display
15 and audio apparatuses.

16 **[0019]** Herein, the step of decoding the digital audio signal comprises the step of transforming the
17 digital audio signal into six signals corresponding to the 5.1 channel audio format.

18 **[0020]** Herein, the audio apparatus is comprised of six speakers applicable to 5.1 channels.

19 **BRIEF DESCRIPTION OF THE DRAWINGS**

20 **[0021]** A more complete appreciation of the present invention, and many of the attendant
21 advantages thereof, will become readily apparent as the same becomes better understood by
22 reference to the following detailed description when considered in conjunction with the

1 accompanying drawings in which like reference symbols indicate the same or similar components,
2 wherein:

3 [0022] Fig. 1 is a block diagram of a system according to the present invention for restoring a
4 digital TV signal according to the principles of the present invention;

5 [0023] Fig. 2a is a block diagram showing a frequency modulation by the audio modulators of Fig.
6 1;

7 [0024] Fig. 2b is a block diagram showing a frequency demodulation by the audio demodulators
8 of Fig. 1;

9 [0025] Fig. 3a is a block diagram showing a frequency modulation by the video modulators of Fig.
10 1;

11 [0026] Fig. 3b is a block diagram showing a frequency demodulation by the video demodulators
12 of Fig. 1;

13 [0027] Fig. 4 is a flow chart of a method according to the present invention for restoring the
14 digital TV signal according to the principles of the present invention; and

15 [0028] Fig. 5 is a conventional system for restoring a digital TV signal.

16 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

17 [0029] Fig. 1 is a block diagram of a system according to the present invention for restoring a
18 digital TV signal. As shown therein, the system according to the present invention for reproducing
19 the digital TV signal is comprised of a computer system 1 and a display system 2.

20 [0030] The computer system 1 comprises a digital TV tuner card 11, a wireless module (wireless
21 transmitter) 18 having a plurality of modulators dividing video and audio signals outputted from the
22 digital TV tuner card 11 to a plurality of channels, and modulating them into high frequency signals,

and an antenna 19 wirelessly transmitting signals modulated by the modulators.

[0031] The display system 2 comprises a plurality of wireless receivers comprising a plurality of antennas receiving the modulated signals transmitted from the computer system 1, a plurality of demodulators demodulating the high frequency signals received through the plurality of antennas, a display apparatus 22 displaying the video signals demodulated by the demodulators, and an audio apparatus outputting the audio signals demodulated by the demodulators.

[0032] The digital TV tuner card 11 includes a tuner 11a receiving the TV signal, a VSB (Vestigial Side Band) demodulating part 11b demodulating a high frequency signal received by the tuner 11a into a VSB analog signal, a viterbi decoder 11c transforming the VSB analog signal into a digital signal, and a demultiplexer 11d dividing the digital signal transformed by the viterbi decoder 11c into the video signal and the audio signal.

[0033] The computer system 1 further comprises a video decoder 14 decoding the video signal, which was compressed by an MPEG-2 manner and received from the digital TV tuner card 11, an AC-3 audio decoder 13 dividing the audio signal into six audio signals corresponding to 5.1 channels and decoding them in an AC-3 manner, a video signal transforming part 15 transforming R/G/B signals decoded by the video decoder 14 into Y/Pb/Pr signals, the wireless module 18 having 1st~3rd video modulators and 4th~9th audio modulators, a signal combiner 12 for combining the signals modulated at the 1st~9th modulators and the antenna 19 wirelessly transmitting the combined signals. Herein, the 1st~3rd modulators respectively modulate the Y/Pb/Pr signals transformed by the video signal transforming part 15 into high frequency signals having an intermediate frequency such as $fc1/fc2/fc3$, and the 4th~9th modulators respectively modulate the six audio signals decoded into high frequency signals having an intermediate frequency such as $fc4/fc5/fc6/fc7/fc8/fc9$ by the audio decoder 13 in the AC-3 manner.

1 [0034] On the other hand, in the display system 2, the antenna 20 receives the Y/Pb/Pr signals
2 transmitted from the computer system 1, and the 1st~3rd demodulators 21 respectively demodulate
3 the high frequency Y/Pb/Pr signals into low frequency signals via the corresponding channels,
4 thereby transmitting the Y/Pb/Pr signals demodulated by the 1st~3rd demodulators to the display
5 apparatus 22. Herein the display apparatus 22 is comprised of the digital TV 22 processing the
6 Y/Pb/Pr signals and displaying them thereon.

7 [0035] The audio apparatus is comprised of a six speakers (not shown) applicable to the 5.1
8 channels and arranged (indoors) at specific positions in which a stereophonic sound can be
9 reproduced. That is, three (front R, front L, center) speakers are arranged in front of a TV viewer,
10 two (rear R, rear L) speakers are arranged in rear of the TV viewer, and one speaker (woofer) outputs
11 a bass sound.

12 [0036] Each speaker of the audio apparatus is comprised of a speaker applicable to the 5.1
13 channels, and connected to the antennas 23a~23f receiving the audio signal transmitted from the
14 antenna 19 of the computer system 1 according to the 5.1 channels, and 4th~9th demodulators 24~29
15 respectively demodulating the high frequency signals received at the antennas 23a~23f according
16 to the 5.1 channels.

17 [0037] Regarding each of the 4th~9th audio modulators, as shown in Fig. 2a the analog audio signal
18 passes through an integrator 31 and an amplifier 32 amplifying the signals, and is then multiplied
19 by sinusoidal wave signal generated from an oscillator 33. Thereafter, the audio signal multiplied
20 by the sinusoidal wave signal is transformed into a negative signal and synthesized with a 90°
21 phase transformed signal generated from the oscillator 33, and is then transformed into a signal
22 within limits of an appropriate frequency band by passing through a frequency multiplier 35.
23 Thereafter, the transformed signal is mixed with a sinusoidal signal generated from a mixer oscillator

36, and then passes through a BPF (band pass filter) 37, to thereby output an FM (Frequency Modulation) signal modulated into a high frequency signal having an intermediate frequency.

[0038] Regarding each of the 4th~9th audio demodulators, as shown in Fig. 2b the demodulation process of the audio signal will be explained. The high frequency FM audio signal is inputted to an RF (Radio frequency) amplifier 41 so as to be amplified. The amplified signal is mixed with a sinusoidal wave signal, generated from a local oscillator 43, by a mixer 42 so as to transform the intermediate frequency, and then inputted to a BPF 46 by passing through an IF (intermediate frequency) amplifier 44 and a hard limiter 45. The signal inputted to the BPF 46 becomes a signal in a specific frequency band by filtering, and then differentiated by a differentiator 47. Thereafter, an envelope of the differentiated signal is detected by an envelope detector 48 so as to be restored to a low frequency analog audio signal.

[0039] Regarding each of the 1st~3rd audio modulators, as shown in Fig. 3a the video signal is multiplied by a sinusoidal wave signal generated from an oscillator 51 and then passes through a Hilbert transformer filter 53 so as to be modulated to a high frequency FM VSB signal. Further, regarding each of the 1st~3rd audio demodulators, as shown in Fig. 3b the high frequency FM VSB video signal is amplified through an RF amplifier 63 and then passes through a low pass filter 65 after being multiplied by a sinusoidal wave signal generated from an oscillator 61 so as to be restored to a low frequency analog video signal.

[0040] As shown in Fig. 4, the steps of S1~S15 shows a process in the computer system 1, and the steps of S17~S21 shows a process in the display system 2. As shown therein, when the tuner 11a receives a TV signal (S1), the VSB demodulating part 11b demodulates the TV signal into the VSB analog signal (S3). Thereafter, the viterbi decoder 11c transforms the demodulated TV signal into a digital signal, and then the demultiplexer 11d divides it into a video signal and an audio signal

(S5). Thereafter, the video decoder 14 decodes the video signal in the MPEG-2 manner so as to get Y/Cb/Cr signals and transforms the Y/Cb/Cr signals into R/G/B signals, and then the video signal transforming part 15 transforms the R/G/B signals into Y/Pb/Pr signals (S7). The Y/Pb/Pr signals are transmitted to the 1st~3rd modulators. Simultaneously with the process of the video signal, the audio signal is decoded into six audio signals corresponding to the 5.1 channels (S11). The decoded audio signals are transmitted to the 4th~9th modulators. The Y/Pb/Pr signals inputted to the 1st~3rd modulators are respectively frequency-modulated into high frequency video signals having an intermediate frequency different each other (S9), and the 5.1 channel audio signals inputted to the 4th~9th modulators are modulated into high frequency audio signals having an intermediate frequency different from each other (S13). The high frequency video and audio signals are wirelessly transmitted to the display system 2 through the antenna 19 (S15).

[0041] The high frequency video signals transmitted from antenna 19 are received through the antenna 20 of the digital TV 22 of the display system 2 (S17). The received video signals are respectively restored to the Y/Pb/Pr signals through the 1st~3rd demodulators and transmitted to the digital TV 22 (S19). The high frequency audio signals are respectively received through the antennas 23a~23f provided at the speakers according to the 5.1 channels, and transmitted to the speakers after being restored to low frequency analog audio signals through the modulators 24~29 connected to the speakers (S21).

[0042] With this configuration, where a digital TV signal received at a digital TV tuner card of a computer system is displayed through a remote display apparatus, the digital TV signal which is comprised of video signals and audio signals according to channels frequency-modulated through a wireless module provided at the computer system is transmitted by wireless, and the transmitted digital TV signals are received by a display system through antennas corresponding to the signals,

1 thereby displaying the digital TV signal without separate cables.

2 **[0043]** As described above, the present invention provides a system and a method for restoring
3 a digital TV signal, in which the digital TV signal is wirelessly transmitted from a computer system
4 and is restored at a remote display apparatus.

5 **[0044]** Although the preferred embodiments of the present invention have been disclosed for
6 illustrative purpose, those skilled in the art will appreciate that various modifications, additions and
7 substitutions are possible, without departing from the scope and spirit of the invention as disclosed
8 in the accompanying claims.